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J. Helminthol. Soc. Wash.
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Research Note

The Presence of *Udonella ophiodontis* in Washington and of *U. caligorum* in British Columbia

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ABSTRACT: The symbiotic flatworm, *Udonella ophiodontis*, was found on copepods, *Lepeophtheirus pravipes* Wilson, 1912 from lingcod, *Ophiodon elongatus* Girard, and on *L. hospitalis* Fraser, 1920 from starry flounder, *Platichthys stellatus* (Pallas) in Washington. The more commonly reported species, *U. caligorum*, was found on *Lepeophtheirus bifidus* Fraser, 1920 and *L. parviventris* Wilson, 1905 on rock sole, *Lepidopsetta bilineata* (Ayers, 1855), and on *L. hospitalis* on starry flounder in British Columbia.

KEY WORDS: *Udonella ophiodontis, Udonella caligorum*, copepod hosts, British Columbia, Washington.

On the theme of "Big fleas have littler fleas," the genus *Udonella* is of particular interest to parasitologists because its members are symbionts on copepods, which are themselves parasites of marine fishes. The systematic position of *Udonella* has been controversial with placement among the monogeneans, in a separate class, or within an order of the Turbellaria as discussed by Beverly-Burton (1984). There are no records of these symbionts from ectoparasitic copepods on fishes of the Canadian Pacific coast of North America (Beverly-Burton, 1984). The lack of records is surprising because Fraser (1920) named the caligid copepod *Lepeophtheirus hospitalis* "on account of the species being host to so many parasites." Fraser commented on the scores of copepods which he found that were covered with parasites and the numerous infected copepods on fishes in the Vancouver Island area. Two species of *Udonella* have been reported in Washington in waters adjacent to British Columbia. Kay (1945) described a new species, *Udonella ophiodontis* from *Lepeophtheirus* sp. from the buccal cavity of lingcod, *Ophiodon elongatus* Girard. Schell (1972) described the early development of *U. caligorum* from eggs taken from *L. hospitalis* on starry flounder, *Platichthys stellatus*

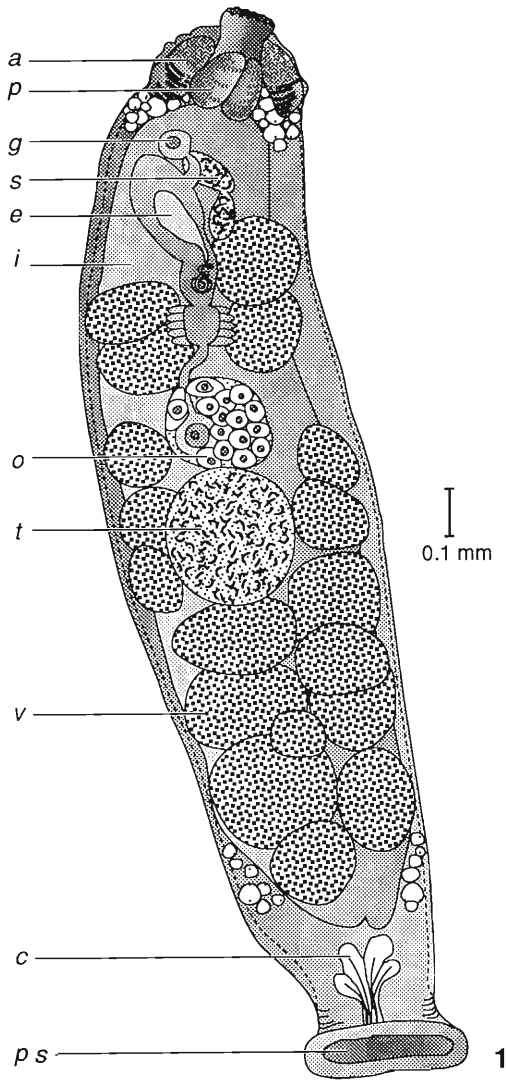

Figure 1. Whole mount, ventral view, of *Udonella ophiodontis* from the copepod *Lepeophtheirus pravipes* from lingcod, *Ophiodon elongatus* in Washington. U.S.N.M. Helminthol. Coll. No. 82442. Abbreviations: a, anterior haptor; c, caudal glands; e, egg; g, genital pore; i, intestine; o, ovary; p, pharynx; ps, posterior sucker; s, seminal vesicle; t, testis; v, vitellarium.

(Pallas). The purpose of this study is to compare the morphology of the 2 species and verify their presence in Pacific waters.

Specimens of *Udonella* spp. were studied from the authors' collections from Washington and British Columbia, the U.S.N.M. Helminthological Collections, and the Harold W. Manter Laboratory Collections. Specimens collected at Friday Harbor, Washington, were fixed in AFA (alcohol–formalin–acetic acid), stained in hematoxylin, and mounted in Permount. When specimens were taken from copepods preserved in 70% alcohol, they were flattened and cleared for study using 95% acetic acid and 5% formalin. Measurements are given in μm unless stated otherwise.

Three specimens of *Udonella* sp. collected from caligid copepods from Washington were compared with 4 specimens on a slide labeled *Udonella socialis,* collected by Linton in 1910 from Dry Tortugas, Florida, U.S.N.M. Helminthol. Coll. No. 8537. Price (1938) considered *U. socialis* to be a synonym of *U. caligorum.* Specimens from this slide were used as the basis for Price's description of *U. caligorum.* The morphology of the specimens from Washington was quite different from *U. caligorum* and similar to the description of *Udonella ophiodontis* by Kay (1945). The most striking difference was the size of the ovary in relation to the testis, which was smaller in *U. ophiodontis* and much larger in *U. caligorum.* The anterior end of *U. ophiodontis* had fewer surface annulations, proportionately smaller anterior haptors, smaller, rounder pharynx, a submarginal genital pore, a bilobed seminal vesicle, and clumped arrangement of caudal glands (Fig. 1). Measurements of 6 specimens of a species of *Udonella* collected from *L. hospitalis* from Washington (H.W.M.L. No. 23888) and figures of the adult and developing stages described by Schell (1972, 1985) as *U. caligorum* matched the description of *L. ophiodontis.* Differences between the 2 species are summarized in Table 1. There may also be differences in the proportion of the gonads in the development and maturation stages. Price (1938) observed that young worms had a testis that was larger than the ovary, a condition verified in young specimens on the slide. Mature specimens had gonads reversed in size with the ovary larger than the testis in *U. caligorum.* Schell (1972) observed differences in the process of gonad maturation in what he called *U. caligorum* in that both testis and ovary appeared at the same time, and in the mature state the testis was larger than the ovary.

New and corrected records

Udonella ophiodontis

1. *Lepeophtheirus pravipes* Wilson, 1912 from the buccal cavity of lingcod, *Ophiodon elongatus,* collected from Friday Harbor, Washington, by Ching, June 1957.

Table 1. Summary of differences between *Udonella ophiodontis* and *U. caligorum*.*

	U. ophiodontis	*U. caligorum*
Body length (mm)	2–2.8	1.1–1.4
Body width	303–743	155–262
Pharynx	164–205 × 131–164 (N = 3)	150–152 × 85–95
Genital pore	Submarginal	On left margin
Testis (transverse diameters)	189–286	76–95
Ovary (transverse diameters)	135–270	133
Ratio of testis/ovary	1:0.7–1:0.9	1:1.7
Egg	147–155 × 74 (N = 2)	133 × 42
Caudal glands	Clumped	2 separate groups
Posterior sucker	245–327	187–210

* Ranges of *U. ophiodontis* based on measurements of 9 specimens unless noted otherwise; measurements of *U. caligorum* taken from Price (1938). All measurements in μm unless stated otherwise.

2. *Lepeophtheirus hospitalis* Fraser, 1920 from *Platichthyes stellatus,* collected near San Juan Island, Washington, by Schell (1972).

Udonella caligorum

1. *Lepeophtheirus bifidus* Fraser, 1920; prevalence of 64/195 or 32.8%.

2. *Lepeophtheirus parviventris* Wilson, 1905; prevalence of 1/26 or 3.9%. *Lepeophtheirus bifidus* and *L. parviventris* were collected from 12 of 31 *Lepidopsetta bilineata* (Ayers, 1855), from Bamfield, British Columbia, Canada, by Leighton in 1980. None of 10 *L. hospitalis* on the fish host was infected including 6 in coinfections with *Udonella*-infected *L. bifidus.*

3. *Lepeophtheirus hospitalis* Fraser, 1920 on *Platichthyes stellatus,* Tsawwassen, British Columbia, Canada, by Leighton in 1982.

Although the presence of *U. caligorum* has been documented, recent searches for other species in British Columbia have been unsuccessful. *Lepeophtheirus breviventris* was collected from lingcod in March 1989, and September 1991, and except for 1 egg attached to 1 copepod, 78 were free of udonellids. Twelve *Lepeophtheirus pravipes* from the fall sampling were also negative.

The report of *U. caligorum* and description of a new species, *Udonella murmanica,* by Kornakova and Timofeeva (1981) appear to differ considerably from the European and North American concepts of the type species. The measurements and figures of both species show much larger, robust flatworms with gonads in the proportions described for *U. ophiodontis.* The clumped arrangement of the caudal glands is also what we have observed for *U. ophiodontis.* The figures and descriptions lack precise information on the anterior surface annulations, anterior suckers, nature of the vitellarian follicles, and nature of the seminal vesicle. Kornakova and Timofeeva (1981) have suggested that *U. caligorum* is a species complex. From the evidence presented here, there are at least 2 species in northeast Pacific waters. We suggest from our data on prevalences that there may be complex interactions between the 2 species, their copepod hosts and their fish hosts, which dictate their distribution and which may be influenced by seasonal and other physical factors. Schell (1972) and our data showed that several species of ectoparasitic copepods may be present on fish but only 1 or 2 harbor worms of the genus *Udonella.* One caligid copepod such as *L. hospitalis* may be host for 2 species as was found in Washington and British Columbia or be negative depending on the abundance of other species of *Lepeophtheirus* present on the fish.

Mary Lou Pritchard kindly measured specimens of *Udonella ophiodontis* deposited in the Manter Laboratory by Schell. Claudia Hand collected caligid copepods from lingcods; Bob Bandoni, Andy Lamb, and Suzanne Spohn provided lingcods for examinations.

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Research Note

Endoparasites of the Bird-voiced Treefrog, *Hyla avivoca* (Anura: Hylidae), from Arkansas

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ABSTRACT: Sixty-one juvenile and adult bird-voiced treefrogs, *Hyla avivoca* Viosca, 1928, were collected from 8 counties of central and southern Arkansas and examined for endoparasites. Thirteen (21%) of the frogs were found to be infected with 1 or more parasites, including 13 of 13 with *Tritrichomonas augusta,* 10 of 13 (77%) with *Opalina* sp., 4 of 13 (31%) with *Nyctotherus cordiformis,* 1 of 61 (2%) with *Megalodiscus temperatus,* 3 of 61 (5%) with *Cylindrotaenia americana,* 4 of 61 (7%) with *Batracholandros bassii,* 2 of 61 (3%) with *Abbreviata* sp., and 5 of 61 (8%) with *Oswaldocruzia* (*Oswaldocruzia*) *pipiens.* All represent new host records for the respective parasites.

KEY WORDS: *Abbreviata* sp., Anura, *Batracholandros bassii,* bird-voiced treefrog, *Cylindrotaenia americana, Hyla avivoca,* Hylidae, intensity, *Megalodiscus temperatus, Nyctotherus cordiformis, Opalina* sp., *Oswaldocruzia pipiens,* prevalence, survey, *Tritrichomonas augusta.*

The bird-voiced treefrog, *Hyla avivoca* Viosca, 1928, is a small anuran that ranges within the Mississippi River and Gulf Coast drainage systems from extreme southern Illinois to South Carolina, Georgia, and Florida westward to parts of Arkansas and Oklahoma (Smith, 1966; Conant and Collins, 1991). The species generally inhabits permanent wooded swamps comprised of tupelo-cypress, birch, and buttonbush. Although much is available on the natural history of related hylids, the biology of *H. avivoca* is not well-known (Trauth and Robinette, 1990; Jamieson et al., 1993), and only 1 report has been published on parasites of this frog. Reiber (1941) reported *Oswaldocruzia waltoni* Ingles, 1936 from *H. avivoca* from Reelfoot Lake, Tennessee, a species inquirenda according to Baker (1987). We report the identity and prevalence of endoparasites infecting *H. avivoca* from southern and central Arkansas.

During May and June 1990 and again between May and July 1991, 61 juvenile and adult *H. avivoca* (58 males, 3 females, mean ± snout–vent length [SVL] = 36.3 ± 0.5, range 31–48 mm) were collected by hand in swampy habitat from 8 counties in central (35°05′N, 92°26′W) and southern (33°19′N, 92°32′W) Arkansas. Of these, a subset of 13 frogs (all males, 36.4 ± 0.7, 33–41 mm SVL) were collected during July 1991 from Conway (N = 6) and Lafayette (N = 7) counties and examined for protozoans, and all 61 were examined for helminths. Frogs were examined within 48 hr of capture. Detailed methods for examining and processing hosts and preparing and staining parasites are identical to those provided by McAllister et al. (1989).

Voucher specimens of parasites are deposited in the U.S. National Museum Parasite Collection (USNM), USDA, Beltsville, Maryland 20705. Voucher specimens of hosts are deposited in the Arkansas State University Museum of Zoology